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ABSTRACT

The higher education community needs measures of the value added to student development by the college experience. The American College Testing Program (ACT) provides a quick, easy method for estimating the extent of student growth in general education. An institution can test seniors with the ACT College Outcome Measures Project (COMP) exam, then subtract from the senior score an estimated freshman score obtained from a "concordance table" that is based on the known relationship (r = .70) between freshman ACT Assessment Composite score and freshman COMP total score. Studies using scores for 4,200 seniors and 2,100 freshmen tested during a two-year period at the University of Tennessee, Knoxville (UTK) indicate that this method is not sufficiently reliable or valid to serve as the basis for making precise judgments about the relative quality of general education programs at various institutions, as at least one state coordinating agency for higher education has attempted to do. These studies show that estimates of student score gain on the COMP exam may be derived from systematically biased samples if not all students have ACT Assessment scores, and can be in error by as much as 60 percent. Moreover, estimated score gain bears a negative relationship to a number of institutional variables generally associated with good practice in higher education. Appendices contain contingent proportions for students with and without ACT scores on selected variables (1984-85 and 1985-86 UTK senior samples) and mean gain scores for selected variables (same periods and same sample). (Author/JAZ)

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ESTIMATED STUDENT SCORE GAIN ON THE ACT COMP EXAM: VALID TOOL FOR INSTITUTIONAL ASSESSMENT?

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ABSTRACT

The higher education community needs measures of the value added to student development by the college experience. ACT provides a quick, easy method for estimating the extent of student growth in general education. An institution can test seniors with the ACT College Outcome Measures Project (COMP) exam, then subtract from the senior score an estimated freshman score obtained from a "concordance table" that is based on the known relationship ($r = .70$) between freshman ACT Assessment Composite score and freshman COMP Total score. Studies using scores for 4200 seniors and 2100 freshmen tested during a two-year period at the University of Tennessee, Knoxville indicate that this method is not sufficiently reliable or valid to serve as the basis for making precise judgments about the relative quality of general education programs at various institutions, as at least one state coordinating agency for higher education has attempted to do. These studies show that estimates of student score gain on the COMP exam may be derived from systematically biased samples if not all students have ACT Assessment scores, and can be in error by as much as 60 percent. Moreover, estimated score gain bears a negative relationship to a number of institutional variables generally associated with good practice in higher education.

CONTENTS

	Page
Purpose	1
Review of Literature	1
Student Score Gain	2
Problems with Estimated Score Gain	5
Standard Deviation of Estimated Gain	5
Stability of the ACT Concordance Tables	6
Reliability of Estimated Gain	9
Missing ACT Assessment Scores	10
Relationships of Selected Variables to Estimated Score Gain	13
Discussion	17
Concerns Related to Reliability	17
Concerns Related to Validity	17
Conclusion	18
References	20
Appendix A	21
Appendix B	27

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Purpose

The College Outcome Measures Project (COMP) exam of the American College Testing Program (ACT) has been available for use by colleges and universities since the academic year 1979-80. The exam was designed "to measure knowledge and skills relevant to successful functioning in adult society" (Forrest, 1982, p. 11). The COMP exam has been administered at least once on some 350 campuses, and it is used annually by approximately 100 four-year institutions for the purposes of assessing and improving their general education programs. Despite this rather substantial base of institutional experience in using the COMP exam, surprisingly few studies have appeared in the literature concerning its technical qualities. The purpose of this paper is to provide some evidence bearing on the reliability and validity of estimated score gain on the COMP, a topic previously unexplored in the literature.

The COMP exam provides a total score and six subscores, three in content areas and three in process areas, as follows:

Content Areas

- Functioning within Social Institutions
- Using Science and Technology
- Using the Arts

Process Areas

- Communicating
- Solving Problems
- Clarifying Values

The exam is available in two forms: the Composite Examination, which contains a multiple-choice section as well as additional exercises that permit students to construct their own written answers and to record a speech; and the Objective Test, consisting of 60 multiple-choice items each of which has two correct responses. The correlation between the Total scores on the Composite and Objective forms is approximately .80. Most of the institutions using the COMP exam on a continuing basis employ the Objective Test because it takes less time for students to complete and is less expensive to administer and score.

Review of Literature

Persistent attempts to locate in the ERIC database institutional studies using the COMP exam have yielded no more than a dozen citations over the years since the instrument was first marketed. Most of the studies are exploratory

in nature, describing the results of an institution's first administration of the instrument to a sample of students.

For example, Jones (1982) reported the outcomes of testing all (93) entering freshmen at Nazareth College in 1980, and a sample of 25 senior volunteers in Spring 1981, using the COMP Objective Test. The freshman and senior groups were found to be equivalent in ability as measured by the ACT Assessment, and the senior mean Total score was 35 points higher than the freshman mean. The conclusion was drawn that for freshmen who remain at Nazareth College for four years, significant growth can be expected in the areas of knowledge and skill assessed by the COMP exam.

Ward and Pringle (1981) tested a total of 99 graduates of non-traditional postsecondary programs in Illinois (a "university without walls" and other individualized programs) and concluded that the COMP Objective Test was not biased against nontraditional students. In fact, the nontraditional sample had higher scores on the Communicating and Using Science and Technology subscales than did a norm group of traditional students from 30 other institutions.

Dumont and Troelstrup (1980) attempted to relate COMP scores for a random sample of 112 seniors at Tennessee Technological University to a series of self-reported ratings of progress toward achieving a set of institution-wide goals for general education. The low correlations obtained indicated that the less expensive self-report data could not be used as a substitute for the COMP exam scores.

Schomberg et al. (1981) also failed to find meaningful relationships between COMP exam scores and self-reports concerning perceived benefits of college and satisfaction with levels of skill and knowledge. The authors' experience in testing 96 graduating seniors at the University of Minnesota led them to conclude that the COMP exam is too easy to differentiate among students of high ability.

In a study involving 696 students in an urban community college setting, Kitabchi (1985) found that entering ability (ACT Assessment Composite) was the most important predictor of success on the COMP exam. Significant relationships also were found with age and racial-ethnic group; older students and white students outscored younger students and blacks.

Student Score Gain

Many colleges and universities are drawn to the COMP exam because it offers the promise of providing objective evidence of student growth in generic knowledge and skills -- "value added" -- over the years of association with an institution. One of the developers of the exam has written,

> "...we strongly recommend that an institution gather and use empirical evidence of the degree to which its general education program is providing intended benefits... We suggest that the empirical evidence include... Student test score gains from entering freshman status to graduation" (Forrest, 1982, p.4).

Since a new form of the COMP exam is developed each year, students who persist at an institution can be tested upon entrance and again at the end of two or four years of college experience with equivalent forms of the same exam. In reality, however, few institutions want to wait even two years to measure the growth their general education program is producing in continuing students. In addition, many institutions are unwilling to invest the resources required to test entering students, and thus administer the COMP exam to graduating students only.

Partially in response to this impatience on the part of institutions, the developers of the COMP exam have offered to provide an estimate of student gain in Total score. Using evidence that the correlation between the Total score achieved by freshmen on the Objective Test and their ACT Assessment Composite score is about .70 (Forrest and Steele, 1982, p. 57), the developers have constructed a concordance table (see Table 1 for the 1986 version) from which institutions may estimate a mean freshman COMP exam score if they have the mean ACT Assessment Composite score for a group of graduating students who have actually taken the COMP. By subtracting the estimated freshman score from the actual score for graduating students, an estimate of score gain, or value-added, can be obtained. The ACT staff provide no estimates of gain on the six COMP subscores, and they caution in the introduction to the concordance table that it is "not appropriate to use to estimate individual student growth."

The developers of the COMP have not published the methodology for constructing their concordance table or its revisions, nor any evidence of the reliability or validity of estimated score gain. The review of literature summarized in the foregoing section of this paper reveals no studies of the reliability or validity of estimated gain.

ACT offers the service of estimating student score gain to institutions using the COMP exam. Many of the more than 100 four year institutions using the COMP annually consider the estimate of gain in assessing the relative effectiveness of their general education program vis-à-vis those of peer institutions and/or institutions in the national norm group. One state coordinating agency, the Tennessee Higher Education Commission, uses the value of estimated score gain as one of five criteria for awarding an annual financial supplement to each of the state's public colleges and universities.

Estimated score gain is being employed increasingly to make decisions that can have a far-reaching impact on institutions of higher education in the United States. Is the importance currently attached to this construct justifiable? Can it be used by institutions to identify strengths and weaknesses of their general education programs and to suggest directions for improving such programs? As more and more states take action to encourage public postsecondary institutions to undertake programs designed to assess student outcomes, can state officials regard estimated score gain as a tool of sufficient reliability and validity to serve as the basis for making precise decisions concerning the relative quality of the general education programs at various institutions?

The University of Tennessee, Knoxville, (UTK) has the most extensive COMP database in the country. Since 1980 several hundred seniors at UTK have been tested annually using the COMP Objective Test. In 1985 the test became a

Table 1

1986 Revised Concordance Table
of ACT Composite Scores and COMP Objective Test
Total Score Equivalent
(Based on 13,552 Entering Freshmen)

Note: It is appropriate to use this table only for estimating the COMP Mean Total Score that a sample of Sophomores or Seniors might have obtained had they taken the COMP Objective Test or Composite Examination instead of the ACT Assessment as High school seniors or entering college freshmen. This table is not appropriate to use to estimate individual student growth.

ACT Composite Scores	Equivalent COMP Total Scores
4	122
5	125
6	126
7	130
8	134
9	138
10	142
11	145
12	149
13	152
14	156
15	159
16	162
17	165
18	168
19	171
20	174
21	177
22	180
23	183
24	186
25	189
26	193
27	196
28	200
29	204
30	208
31	213
32	217
33	221
34	226

graduation requirement for every senior, and during 1985-86 it was administered to over 3,000 seniors. Since 1983 at least 600 freshmen have been tested annually at the beginning of their first quarter at UTK. In 1985, and again in 1986, approximately 1,800 freshmen, or half of the first-time full-time freshmen, took the COMP exam. UTK is in a unique position to provide evidence of the technical quality of estimated student score gain on the ACT COMP Objective Test.

Problems with Estimated Score Gain

For three years systematic studies have been conducted using the COMP database at the University of Tennessee, Knoxville. The following problems with estimated gain have been discovered, confirmed, and reconfirmed on successive data sets.

1. Estimated gain has a large standard deviation.

2. The regression equations used to estimate freshman COMP scores from entering ACT Assessment scores differ significantly from one student cohort to another. Thus the ACT staff must re-calibrate its concordance table periodically and issue revisions. Actual testing of UTK freshmen has revealed that use of these concordance tables results in a significant over-estimate of the mean UTK freshman COMP score, and thus a significant under-estimate of gain at UTK.

3. Estimated gain is a change score -- the difference between scores on two tests of imperfect reliability -- and thus is less reliable than either of the tests used in its computation.

4. A significant proportion of graduating seniors has no ACT Assessment Composite score upon which to base an estimate of freshman COMP score. Moreover, seniors without entering ACT scores differ in systematic ways from those who have such scores.

5. The validity of estimated score gain as an indicator of the effectiveness of an institution's general education program is called into serious question on the basis of a series of counter-intuitive relationships found to exist between estimated gain and certain demographic and institutional variables.

An explanation of each of these findings appears in the paragraphs that follow.

Standard Deviation of Estimated Gain

The estimate of COMP score gain based on the freshman ACT Assessment Composite score has a large standard deviation. The data in Table 2 provide evidence of the variability of ACT Assessment Composite scores, senior COMP Total scores and estimated COMP score gain for UTK seniors who took the COMP in 1985* and in 1986*. While the mean estimated gain is less than half the value of the ACT score, its standard deviation is almost three times that of ACT scores. The value of the standard deviation of estimated gain for 1986 is 60 percent greater than the value of the mean itself; and the 95 percent confidence interval for the 1985 mean is almost 20 percent of the value of the

mean, thus indicating that in a given year the level of estimated gain for UTK could be in error by as much as 20 percent.

Table 2. Variability of ACT Assessment Composite Score, Senior COMP Total Score, and Estimated COMP Total Score Gain for UTK Seniors taking COMP in 1985* and 1986*.

Variable	N	Mean	Standard Deviation
ACT Score			
1985	902	21.26	4.89
1986	2259	21.81	4.73
Senior COMP Total Score			
1985	1284	187.91	15.99
1986	3276	188.81	16.08
Estimated Gain			
1985	843	9.16	12.81
1986	2226	8.81	14.27

*For convenience the samples are labeled 1985 and 1986 in the narrative. Actually, the 1985 sample includes seniors tested during the four quarters Fall 1984 and Winter, Spring, and Summer 1985. Likewise, the 1986 sample includes students tested between Fall Quarter 1985 and Summer Quarter 1986.

Stability of the ACT Concordance Tables

To facilitate the estimation of gain in Total score on the COMP exam, (gain on the six subscales is not estimated by ACT) its developers periodically provide institutional users with a concordance table that pairs ACT Assessment Composite scores with COMP Total scores (see Table 1). The concordance table, which may be used to estimate a freshman COMP Total score for any student with an ACT Assessment Score, was first issued in 1983, then revised and reissued in 1983, 1985, and 1986.

In the absence of a complete description of the methodology for constructing the concordance table, the best guess about its derivation is that bivariate regression was used to relate freshman ACT Assessment Composite scores to COMP Total scores for a sample of freshmen who took the COMP exam. Then selected points from the least squares regression line relating the two tests were used in the concordance table.

Employing this technique, the regression equation for the "1983 Revised Concordance Table" was found to be (3.13837 * ACT score) + 113.31038. This equation summarizes the concordance table quite adequately: a correlation

coefficient of .998 was calculated between the best fit equation and the concordance table.

To date there are three revisions of the original concordance table, each described by a different regression equation (see Figure 1). For the 1985 revision, the formula is (3.11746 * ACT score) + 113.36025, and for the 1986 revision it is (3.36573 * ACT score) + 107.37379. Not surprisingly, the three regression lines, based on three different student samples, are significantly different from one another. This instability of the concordance table from year to year complicates greatly the process of estimating score gain for seniors, since the estimated freshman COMP score for seniors having taken the ACT Assessment in different years must be derived from several concordance tables.

In an effort to test the accuracy of the ACT concordance tables in estimating freshman COMP scores at UTK, freshman score estimates derived from the appropriate ACT Revised Concordance Tables were compared with actual freshman scores for 1637 freshmen who took the COMP in 1984 and 1985. A t-test for paired measures revealed a significant difference ($t = 18.46$; $p < .0001$) between the estimated and actual freshman COMP scores. In fact, the estimate of the average freshman Total score derived from the ACT concordance table was 6 points higher than the actual average Total score achieved by UTK freshmen. Since score gain is figured by the ACT staff by subtracting the estimated average freshman COMP Total score from the actual average COMP Total Score attained by seniors, this finding means that the ACT estimate of student score gain for UTK seniors -- which, for the years under consideration was 10 -- was 6 points lower than it should have been.

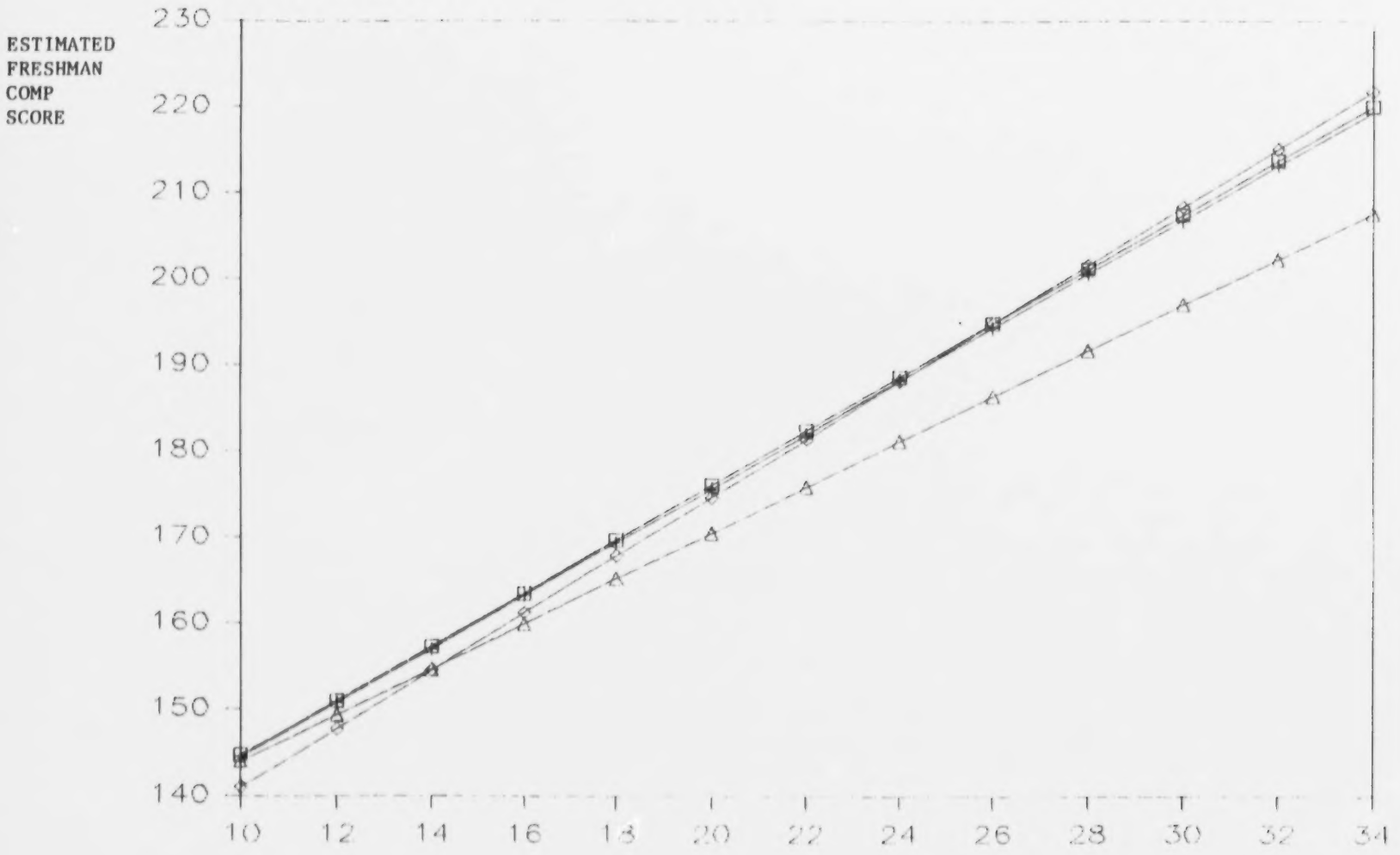
While these results need to be confirmed by studies at other institutions, it is worthy of emphasis that use of the ACT concordance tables produces estimates of score gain on at least one campus that are substantially different from estimates based on actual freshman COMP scores at that institution. In fact, the ACT estimate of score gain for UTK seniors in 1985 and 1986 was in error by 60 percent -- it was 60 percent lower than it should have been.

Regression analysis was used to describe more accurately the relationship between freshman ACT Assessment scores and actual COMP Total scores for UTK freshmen. The resulting regression equation for estimating COMP Total from ACT Composite was (2.64705 * ACT Score) + 117.61108. This equation explained 51 percent of the variance in actual freshman COMP scores. Examination of the variance not explained by the equation indicated that the residuals were randomly distributed about a mean of 0.00.

The line described by this equation is plotted in Figure 1 with the three lines that define the points on the ACT concordance tables, making the statistically significant differences visually apparent. Figure 1 also illustrates the fact that high ability students were most disadvantaged by the application of the ACT estimate. For freshmen with ACT scores of 28 or higher, COMP scores estimated by the ACT staff were 10 points higher than the actual COMP scores achieved. As a result, ACT underestimated gain by 10 points for this group.

FIGURE 1

REGRESSION LINES FOR CONCORDANCE TABLES



□ = ACT 1983 Revised Concordance Table + = 1985 Revised Concordance Table ◇ = 1986 Revised Concordance Table

△ = UTK Concordance Table Based on Freshmen Tested in 1984 and 1985

Reliability of Estimated Gain

Isaac and Michael (1981) have defined reliability as the reproducibility (repeatability) of a measure, the internal consistency of a measure, or the extent to which a measure represents a "true" test score. According to these authors, an important property of the reliability coefficient is that it indicates the extent to which variability in a score represents true score variance rather than error. For example, if the reliability coefficient for a given instrument is .80, this means that 80 percent of the variation in scores on this instrument is attributable to true score variance. The remaining 20 percent of the variation may be attributed to error.

Obviously, efforts to assess student outcomes of higher education must be based on reliable indicators, particularly when resource allocation decisions are based on the results of assessment as they are in Tennessee. Studies carried out at the University of Tennessee, Knoxville have confirmed the conclusion of the test developers that the internal consistency of the COMP Objective Test is adequate for use in program evaluation. Forrest and Steele (1982, p.57) have reported a Cronbach alpha estimate of .84, and the UTK estimate of alpha reliability is .76. The estimate of internal consistency for the ACT Assessment is .85 (ACT, 1973).

Since the estimate of score gain on the COMP is based on the score obtained from two instruments of acceptable reliability, common sense would suggest that estimated score gain also would have acceptable reliability. In reality however, estimated gain is a difference score, and has much lower reliability than might be assigned. When scores from correlated measures are subtracted from each other, the resulting difference includes more of the unreliability, or error variance, and less of the true score variance than does either score taken individually (Ferguson, 1981).

Ferguson has proposed the following equation to assess the reliability of a difference score:

$$r_{dd} = (r_{xx} + r_{yy} - 2r_{xy}) / (2 - 2r_{xy})$$

Where:

r_{dd} = the reliability of the difference score (estimated gain);

r_{xx} = the reliability of the initial measure (ACT Assessment score, and thus estimated freshman COMP score);

r_{yy} = the reliability of the subsequent measure (senior COMP); and

r_{xy} = the correlation between the initial and subsequent measure.

This equation has been used to calculate the reliability of estimated gain -- first using data reported by the ACT developers and then data derived from testing seniors at UTK.

Forrest and Steele have reported a correlation coefficient of .60 between ACT Assessment Composite scores and COMP Objective Test Total scores for 257 seniors (1982, p.57). Since the estimated freshman COMP score is simply a

transformation of the ACT Assessment score (see the discussion of the construction of the concordance tables in the preceding section), an estimate of the reliability of estimated gain can be calculated as follows using Ferguson's equation.

$$r = \frac{.85 + .84 - (2 * .60)}{2 - (2 * .60)}$$

$$r = .61$$

UTK studies using senior and freshman COMP scores for 1985 yield a reliability coefficient of .76 for the senior COMP score and .65 as the intercorrelation between freshman and senior scores. Using these figures in Ferguson's equation, the reliability of estimated gain is .44.

Using UTK data for 1986, the reliability of the senior COMP score is .76, and the intercorrelation between freshman and senior scores is .58. These figures yield an estimate of reliability of .54.

With either of the UTK estimates of the reliability of estimated gain, about half of the gain score is due to error rather than true score. This finding is one more piece of evidence that the level of dependability of estimated gain is simply too low to serve as the basis for making decisions about program quality or the allocation of resources.

Missing ACT Assessment Scores

About a third of the students achieving senior status at UTK have no ACT Assessment Composite score to use in calculating an estimate of score gain on the COMP exam. The data in Table 3 illustrate the fact that in the years since the COMP exam has been given at UTK, the annual percentage of the senior sample without ACT Assessment scores has ranged from a low of 17 to a high of 45, with an average of 32.

Table 3. Sizes of Samples of University of Tennessee Seniors Taking the COMP Exam and Having No ACT Composite Score-1980-1986

	1980	1981	1982	1983	1984	1985	1986	1980-86* Average
# Seniors Taking COMP	165	680	644	700	851	1028	3195	
# w/o ACT Composite	46	NA	177	318	148	357	1023	
Percentage w/o ACT Composite	28%	NA	27%	45%	17%	35%	32%	32%

*Figures based on reports compiled by ACT; summer test scores not included.

The problem of having a large proportion of students without an ACT Assessment score to use in estimating gain on the COMP is not unique to UTK.

In many institutions that use academic aptitude test scores in making admissions decisions at the freshman level, there are international and non-traditional students for whom the requirement for submitting these scores is waived. Moreover, students who transfer to the institution with at least sophomore status may be admitted primarily on the basis of their academic performance at other institutions, and once again the requirement that they submit evidence of entry-level ability is waived.

The fact that qualitative decisions about an institution's general education curriculum may be made on the basis of a calculation that excludes one-third of the population experiencing that curriculum is sufficiently troublesome to raise doubts about the validity of estimated score gain. But if one could demonstrate that the students excluded did not differ in any important ways from the included group, some of the doubt could be dispelled. In point of fact, at UTK there are systematic differences between seniors who have ACT Assessment scores and those who do not. These differences are illustrated in Table 4 and Appendix A.

UTK seniors in 1985 and 1986 were divided into two groups -- those having ACT Assessment scores and those without them. The two groups were compared on some 50 variables, including demographic characteristics, participation in campus activities, and satisfaction with experience at the University. Separate chi-square analyses were conducted for each year, and a rather conservative (.01) level of significance was employed due to the large sample sizes (1,381 in 1985 and 3,520 in 1986) and the large number of statistical tests performed.

Even if the additional restriction of using only the variables found to differentiate those with and without ACT scores in both years is applied, there are clear distinctions between the two groups on such fundamental characteristics as age, racial-ethnic group, parents' level of education, and parents' income. UTK seniors without ACT scores in 1985 and 1986 were older and more likely to be black, come from lower-income families, and have parents possessing less than a high school education.

Seniors without entering ACT Assessment scores also had lower high school grades and were less likely to receive an academic scholarship for college. They were more likely to have transferred to UTK from another institution. They tended to live off campus and not to participate as frequently as students having ACT scores in such campus activities as intramural sports, the film series, concerts, and plays. In keeping with their limited level of involvement in campus life, seniors without ACT scores were less satisfied with their social experience at UTK, and less satisfied with their overall college experience than were their more-involved peers possessing ACT scores.

Estimating the impact on overall COMP score gain of eliminating students without ACT Assessment scores is problematic. The demographic indicators coupled with the lower high school GPA suggest that this third of the senior class would have a lower average ACT Composite score if this measure of their academic aptitude were available. At least at UTK, students with lower

TABLE 4

Chi-Square Results for Differences Between Students With ACT Scores and Students Without ACT Scores on Selected Variables (1985 and 1986 Seniors)

Question	1984-85 df	1984-85 X^2	1985-86 df	1985-86 X^2
Student's Race	1	8.235*	1	293.108**
Gender	1	2.631	1	3.722
Marital Status	1	1.174	1	4.019
Transfer Students	1	348.806**	1	469.832**
High School GPA	1	17.701**	1	32.974**
College GPA	1	0.171	1	1.196
Type of Community	4	10.073	4	10.350
Mother's Education	5	45.490**	5	98.509**
Father's Education	5	53.226**	5	109.057**
Parents' Income	8	49.594**	8	95.682**
Received Academic Scholarship	1	29.615**	1	46.709**
Received Grant or Loan	1	0.321	1	0.383
Where the Student Lives	4	22.658**	4	55.424**
Where the Student Works	2	1.527	2	18.823**
Hours per Week -- Working	4	7.192	5	77.733**
Hours per Week -- Studying	5	3.220	5	5.201
Hours per Week -- Library	5	10.532	5	11.170
Hours per Week -- Pleasure Reading	5	7.97	5	3.986
Hours per Week -- Television	5	5.852	5	12.450
Hours per Week -- Social Activities	5	35.032**		
Hours per Week -- Class			5	38.320**
Commuter Student	2	23.371**		
Participate in Freshman Orientation			2	123.704**
Member Club or Professional Org.	1	2.121	1	28.591**
Participate Internship	1	2.988	1	4.643
Participate Co-op Program	1	1.020	1	0.611
Participate University Studies	1	0.095	1	3.015
Participate College Scholars	1	1.623	1	0.740
Participate Honors English	1	24.099**	1	33.908**
Participate Honors Math	1	1.755	1	2.614
Campus Plays Attended	4	57.127**	4	81.143**
Campus Films Attended	4	39.361**	4	93.391**
Campus Concerts Attended	4	52.807**	4	87.323**
Used Career Planning & Placement	1	9.074	1	32.299**
Participate Intramural Sports	3	55.946**	3	87.669**
Used Student Counseling Center	3	0.903	3	14.557*
Used Student Employment Center	3	2.408	3	2.398
Used Computer Center	3	1.219	3	18.182**
Close Relationship With Faculty	3	6.673	3	5.376
Hours per Week on Campus	3	33.460**	3	53.621**
Foreign Language Coursework	2	4.653	2	7.008
Natural Science Coursework	4	2.830	4	90.384**
Mathematics Coursework	4	9.462	4	188.346**
Humanities Coursework	6	4.890	6	114.984**
Social/Applied Sciences Coursework	6	13.941	6	168.239**
History Coursework	3	49.536**	3	5.903
Satisfaction with Social Experience	3	18.232**	3	30.779**
Satisfaction with Academic Experience	3	13.105*	3	5.603
Satisfaction with Overall Experience	3	12.288*	3	15.703**
Expectation of Overall Experience	2	3.644	2	2.288
Offered Job Upon Graduation	2	5.281	2	2.977
Admitted Graduate Professional School	2	5.409	2	2.492
Plan to Remain in Tennessee	2	0.694	2	12.430*

A detailed presentation of significant results is contained in Appendix A.

entering ACT scores stand to benefit more than those with high scores from their college experience as evidenced by gain in COMP scores (see Table 5). On the other hand, students who are highly involved in the campus experience generally are assumed to profit more from it (National Institute of Education, 1984), and students without ACT Assessment scores appear to be far less invested in campus activities than their peers who have these scores. The only way to tell whether the COMP exam scores of students without freshman ACT scores will have a negative or positive (or neutral) impact on overall campus gain on the COMP exam is to give the COMP to samples of freshmen with and without ACT scores, then wait until these students become seniors, administer the COMP again, and compare their respective levels of score gain (or loss).

Relationships of Selected Variables to Estimated Score Gain

ACT staff have not published any information about the relationship between ability and estimated score gain on the COMP exam. Inspection of the "COMP Gain" column in Table 5 provokes speculation that there is an inverse relationship between ability, as measured by the ACT Assessment Composite score, and estimated score gain on the COMP exam. Studies conducted at UTK have yielded a Pearson correlation of -.44 between ACT Composite and estimated gain.

These data indicate that students with the lowest entering ACT scores have the best chance of achieving high gain scores on the COMP exam as seniors. Because the test has a low ceiling (Schomberg et al., 1981), freshmen with ACT Assessment scores of 28 or higher routinely score 200 or more of the possible 240 points on the exam, and thus have little chance of achieving large score gains when they take the COMP a second time as seniors. In fact, due to the statistical phenomenon of regression toward the mean, students with ACT Assessment scores above 30 who achieve very high scores on the COMP as freshmen are likely to make lower scores when they take the COMP again as seniors.

No studies linking student experiences to actual COMP score gain have appeared in the literature. Since few, if any, four-year institutions have substantial numbers of students who have taken the COMP Objective Test as freshmen and again as seniors, little is known about longitudinal gain on the COMP. Freshmen were first tested at UTK in Fall 1983; thus the first studies involving actual score gain at this institution are not likely to be done for another year.

Most institutions administer the COMP exam with the hope that students' scores will provide some indication of the success of the general education curriculum, and suggest directions for change that may improve the program. Since it has been amply demonstrated that COMP exam scores are largely a function of student ability (Kitabchi, 1985 and Forrest and Steele, 1982), many institutions have focused attention on score gain as the better indicator of the effectiveness of the general education program. As institutions consider the estimates of score gain provided by ACT, it would be very helpful if they could obtain some suggestions for actions that might serve to increase this gain.

However, research using the UTK data on score gain does not provide the kind of direction for program improvement that most institutions would want to

Table 5
Senior COMP Mean,
Estimated Gain Mean, and
Standard Deviation of Gain
by ACT Composite Score
for 1985 and 1986 UTK Seniors

ACT Score	N	COMP Mean	GAIN Mean	STD. Dev.
9	13	166.69	27.31	16.69
10	21	167.19	25.43	13.60
11	32	173.44	27.56	12.23
12	42	168.52	19.24	14.95
13	54	175.52	23.63	14.95
14	84	173.99	19.02	15.37
15	91	177.70	19.20	12.47
16	115	178.44	16.94	13.70
17	159	181.35	16.05	12.54
18	173	182.69	14.42	12.41
19	188	183.97	12.32	11.89
20	196	186.21	10.95	12.70
21	256	188.41	10.12	12.16
22	263	190.89	9.60	12.22
23	237	192.68	7.68	9.69
24	211	192.44	4.44	12.64
25	218	194.65	2.90	11.83
26	210	197.19	2.42	10.07
27	167	198.50	0.50	10.85
28	130	201.45	-0.25	9.92
29	98	202.07	-2.66	12.24
30	59	205.64	-2.12	11.48
31	25	208.96	-2.88	7.22
32	12	207.92	-6.25	8.79

receive. In fact, the relationships with score gain that have been identified merely confirm the negative association with ability; gain is negatively related to variables generally associated with positive educational outcomes.

For each UTK senior taking the COMP exam in 1985 or 1986 an estimate of score gain was calculated in the following way:

1) An estimated freshman COMP score was obtained from the ACT concordance table using the senior's entering ACT Assessment Composite score, then

2) The estimated freshman COMP score was subtracted from the actual senior COMP score.

The derived gain scores were used in a series of one-way analyses of variance. Categorical variables included a variety of demographic characteristics, campus experiences, and indicators of satisfaction. Separate analyses were conducted using the 1985 and 1986 data. Due to the large numbers of students involved -- 796 in 1985 and 2100 in 1986 -- the .01 level of significance was used to identify variables associated with score gain (see Table 6 and Appendix B).

Factors found to be associated with the greatest mean gain in both years include:

- High school grade point average less than 3.00 (B average)
- Not receiving an academic scholarship
- Father's education less than college graduate (Highest gain associated with less than high school education)
- Non-participation in Honors English sections
- Non-participation in Honors Math sections
- Taking no more than two math courses
- Taking either one or no social science course or five or more such courses.

Adding factors associated with gain in at least one of the two years, the evidence mounts that gain is negatively related to ability and to actions generally thought to contribute to student growth. In either 1985 or 1986 the greatest estimated COMP score gain was associated with the following:

- College GPA less than 3.00 (B average)
- Living at least a mile off campus and commuting to UTK
- Working off campus
- Working for at least 10 hours per week
- Not even knowing about the orientation program for freshmen
- Using the Computing Center as little as possible
- Taking as little natural science course work as possible

Table 6
Analysis of Variance Results for Estimated COMP Gain
(1985 and 1986 UTK Seniors)

Question	1984-85		1985-86	
	df	F	df	F
Student's Race	1,794	0.18	1,2098	0.07
Gender	1,794	1.16	1,2098	1.01
Marital Status	1,794	2.01	1,2098	2.94
Transfer Students	1,798	1.92	1,2124	9.15**
High School GPA	1,650	14.74**	1,2098	0.07
College GPA	1,715	4.6	1,1891	51.11
Type of Community	4,780	0.88	4,1871	2.30
Mother's Education	5,782	0.89	5,1867	2.77
Father's Education	5,778	4.74	5,1860	5.08
Parents' Income	8,764	1.69	8,1825	2.34
Received Academic Scholarship	1,788	11.14**	1,1878	39.06
Received Grant or Loan	1,788	2.81	1,1871	4.10
Where the Student Lives	4,780	1.66	3,1872	3.84
Where the Student Works	2,774	7.45**	2,1853	2.65
Hours per Week--Working	4,773	4.63	5,1852	0.85
Hours per Week--Studying	5,781	2.22	5,1871	2.55
Hours per Week--Library	5,781	3.36*	5,1873	5.13**
Hours per Week--Pleasure Reading	5,782	0.93	5,1874	2.05
Hours per Week--Television	5,783	0.86	5,1873	2.37
Hours per Week--Social Activities	5,782	1.93		
Hours per Week--Class			5,1871	1.17
Commuter Student	2,784	4.94*		
Participate in Freshman Orientation			2.1871	5.86
Member Club or Professional Org.	1,785	0.58	1,1876	1.30
Participate Internship	1,785	2.53	1,1877	1.12
Participate Co-op Program	1,786	0.36	1,1878	6.04
Participate University Studies	1,785	0.30	1,1879	1.74
Participate College Scholars	1,785	0.34	1,1876	1.77
Participate Honors English	1,784	10.57	1,1876	30.32**
Participate Honors Math	1,784	9.43*	1,1876	16.37**
Campus Plays Attended	4,785	0.43	4,1876	2.89
Campus Films Attended	4,784	1.33	4,1875	2.39
Campus Concerts Attended	4,785	1.79	4,1876	1.74
Used Career Planning & Placement	1,785	4.27	1,1876	0.53
Participate Intramural Sports	3,785	1.59	3,1877	0.85
Used Student Counseling Center	3,784	1.90	3,1877	1.29
Used Student Employment Center	3,783	0.23	3,1877	0.75
Used Computer Center	3,785	2.07	3,1875	6.82**
Close Relationship with Faculty	3,782	3.46	3,1876	1.48
Hours per Week on Campus	3,782	2.92	3,1875	2.29
Foreign Language Coursework	2,504	4.32	2,1248	2.39
Natural Science Coursework	4,791	2.30	4,2092	7.25**
Mathematics Coursework	4,786	4.18*	4,2077	19.02**
Humanities Coursework	6,783	1.40	6,2079	1.87
Social/Applied Sciences Coursework	6,788	4.06**	6,2086	6.70**
History Coursework	3,792	1.24	3,2079	0.56
Satisfaction with Social Exper.	3,783	0.24	3,1870	1.21
Satisfaction with Academic Exper.	3,783	0.70	3,1875	1.25
Satisfaction with Overall Exper.	3,783	1.38	3,1874	1.07
Expectation of Overall Experience	2,783	0.02	2,1871	0.28
Offered Job Upon Graduation	2,781	2.79	2,1859	1.44
Admitted Graduate/Prof. School	2,780	2.11	2,1862	4.08
Plan to Remain in Tennessee	2,783	0.06	2,1873	4.43

*A detailed presentation of significant results is contained in Appendix B.

Discussion

Over the past three years a group of researchers at the University of Tennessee, Knoxville have used the University's extensive database on the ACT COMP Objective Test to investigate the concept of estimated score gain, or "value added" as those interested in accountability issues have called it. This work has led to the identification of five areas of concern that raise grave doubts about the reliability and validity of estimated score gain on the COMP exam. Three of the concerns are directly related to reliability; however, as an unreliable instrument or method is also invalid, these matters also have an important bearing on validity. Two of the concerns are clearly validity issues.

Concerns Related to Reliability

Work on three separate issues has produced strong evidence that estimated score gain does not have acceptable reliability. The first issue is a simple one of variability. Estimated COMP gain scores for 3,069 UTK seniors tested in two academic years were found to have such large standard deviations that in a given year the estimate of gain for the senior class could be in error by as much as 20 percent.

Since 1983 ACT staff have issued four concordance tables for use in estimating COMP score gain. Investigations undertaken at UTK have revealed significant differences among these tables, and between estimates of score gain derived from the concordance tables and those derived from actual COMP exam scores earned by UTK freshmen. In two recent years use of the ACT concordance tables to estimate COMP score gain for UTK seniors produced a level of gain 60 percent lower than that calculated from actual freshman COMP scores.

Estimated gain is a change score -- the difference between actual COMP score and an estimate of the freshman COMP score based on the entering level of ability as measured by the ACT Assessment score -- and thus its reliability is lower than the reliability of either of the measures on which it is based. Using measures of internal consistency and the intercorrelation of COMP scores achieved by UTK freshmen and seniors in the calculation, reliability coefficients of .44 and .54 were obtained. Roughly half of the estimated gain score is attributable to error of measurement rather than true score.

Concerns Related to Validity

An institution hoping to obtain an indication of student growth in generic skills and knowledge fostered by its general education program must utilize a measure that is applicable to a valid sample of its undergraduates. For many senior institutions, no standardized measure of entering ability such as ACT or SAT score -- the measure upon which estimated COMP score gain is based -- is available for a significant proportion of its graduates. At UTK one-third of the seniors do not have an ACT or SAT (which can be converted to ACT) score. Moreover, there are systematic differences between the group of seniors without such scores and the group having them. Seniors with no measure of entry level ability are more likely to be transfer students, older than average, from low-income families, and members of the black student population. No estimate of score gain based on entering ACT Assessment

Composite scores can be considered valid for program evaluation at UTK because it is calculated using an invalid, i.e., unrepresentative, sample of students.

One final indication of the invalidity of estimated score gain on the COMP exam is provided by a series of relationships with gain discovered in the course of the preliminary analyses conducted at UTK. One would hope that such research would suggest directions for program improvement that are consistent with those derived from conventional wisdom concerning good practice and the current literature in higher education. On the contrary, simple one-way analyses of variance provided no support for a number of programs and practices generally considered beneficial for college students. For example, estimated score gain is higher for students who have not participated in the University's freshman orientation program, have not yet received an academic scholarship, have not taken honors sections of English or math, have taken little or no natural science and no more than two math courses, have seldom used the Computing Center, have resided at least a mile off campus, and have worked off campus at least 10 hours per week.

The nature of many of the foregoing relationships is such that this facet of the research seems merely to confirm in a practical sense the statistical finding that there is a significant negative correlation between student ability and estimated score gain on the COMP. At least in using the current list of some 50 variables available for association with estimated gain at UTK, the relationships identified to date suggest no positive actions that could be taken by an institution to improve its general education program.

Conclusion

The ACT COMP exam has been demonstrated to be a valuable tool for stimulating faculty discussion about the general education curriculum, and modes of instruction, at colleges and universities across the country. The foregoing research does not detract from this substantial contribution to the improvement of the general education experience for the nation's college students.

What is called into question is the usefulness, the validity, of employing <u>estimated</u> student score gain on the COMP for the purpose of making precise judgments about program quality that can serve as the basis for decisions about the allocation of resources in higher education. Estimated score gain is just that -- an estimate. It might be used in making some gross distinctions between institutions that contribute to extraordinary student growth in generic knowledge and skills over four years and those that make little or no contribution to such growth. But even this notion is merely speculative until confirmed through further research. To date we have only <u>post hoc</u> correlational studies, not the controlled experiments that are needed, to judge the efficacy of student score gain as an indicator of program quality.

No institution can have a clear idea of the amount of student growth its general education program may be promoting until it tests its own incoming students, then administers an equivalent form of the same test to graduates. Longitudinal studies at a wide variety of institutions with very different approaches to general education should shed some light on the validity of using <u>actual</u> score gain in program evaluation.

It must be pointed out that there may be problems with the reliability and validity of actual score gain as well. Actual score gain is still a change score, dependent on two measures of imperfect reliability. Freshmen who have taken the COMP exam will have had some practice that will influence their performance on the exam when they take it as seniors. (If all students have ACT or SAT scores, this effect could be minimized in a cross-sectional study in which gain is calculated by testing freshmen and preparing an institutional concordance table to serve as the basis for comparing scores of seniors of various ability levels.) Due to the ceiling effect, students of high ability who achieve high scores on the COMP as freshmen will not be able to show substantial growth in their scores as seniors. Above all, there are enormous problems inherent in attempting to separate the effects on student development of a college curriculum as compared with all of the other life experiences students encounter during their years of association with the institution. However, actual score gain will surely be an improvement over estimated gain in terms of its technical qualities.

The state of the art of measurement is sufficiently primitive for us to make the statement that we have just begun to scratch the surface in exploring the usefulness of tests and measures for the purpose of assessing program effectiveness in higher education. Appropriate caution must be exercised in not applying certain measurements in decision-making before they are capable of providing information for making judgments of the precision required. Estimated score gain on the ACT COMP exam is not a measure that can furnish data for precise decisions. Additional research by many institutions is required to improve the quality of information that can be derived from score gain on the COMP. Such research will be costly and difficult, but it is imperative if educators and the public they serve are to be able to place confidence in score gain on the COMP exam as an indicator of program quality.

REFERENCES

American College Testing Program (1973). Highlights of the ACT Technical Report. Iowa City, Iowa: ACT Publications.

Dumont, R.G., & Troelstrup, R.L. (1980). Exploring relationships between objective and subjective measures of instructional outcomes. Research in Higher Education, 12 (1), 37-51.

Ferguson, G.A. (1981). Statistical Analysis in Psychology and Education. New York: McGraw-Hill.

Forrest, A. (1982). Increasing Student Competence & Persistence: The Best Case for General Education. Iowa City, Iowa: The ACT National Center for the Advancement of Educational Practices.

Forrest, A., & Steele, J.M. (1982). Defining and Measuring General Education Knowledge and Skills. Iowa City, Iowa: The American College Testing Program.

National Institute of Education (October 1984). Involvement in Learning: Realizing the Potential of American Higher Education. Report of the Study Group on the Conditions of Excellence in American Higher Education. Stock No. 065-000-00213-2 Washington, D.C.: U.S. Government Printing Office.

Isaac, S., & Michael, W. (1981). Handbook on Research and Evaluation (2nd Ed.). San Diego: EDITS Publishers.

Jones, V. (1982). Report on the Use of the COMP Objective Test and Activity Inventory to Assess Nazareth College General Evaluation Outcomes. Kalamazoo, Michigan: Nazareth College (ERIC Document Reproduction Service No. ED 219 025).

Kitabchi, G. (1985). "Multivariate Analyses of Urban Community College Student Performance on ACT College Outcomes Measures Program Test." Paper presented at the Annual Meeting of the American Educational Research Association March 31 - April 4, 1985 (ERIC Document Reproduction Service No. ED 261 091).

Schomberg, S.F., Hendel, D.D., & Bassett, C.L. (1981). "Using the College Outcome Measurement Project to Measure College Outcomes." Paper presented at the Annual Forum of the Association for Institutional Research, Minneapolis, May 17-20, 1981 (ERIC Document Reproduction Service No. ED 205 121).

Ward, E.F., & Pringle, R.A. (1981). The ACT College Outcome Measurement Project: A New Tool for Summative Evaluation of Nontraditional Postsecondary Education Programs? Washington, D.C.: U.S. Office of Education (ERIC Document Reproduction Service No. ED 217 072).

APPENDIX A:
CONTINGENT PROPORTIONS FOR STUDENTS WITH AND WITHOUT ACT SCORES
ON SELECTED VARIABLES
(1984-85 and 1985-86 UTK Senior Samples)

STUDENT'S RACE (1984-85)

	White	N.White
ACT	0.93	0.07
Non-ACT	0.88	0.12
TOTAL	0.91	0.09

X^2=8.235; df=1; p<.01

STUDENT'S RACE (1985-86)

	White	N.White
ACT	0.95	0.05
Non-ACT	0.75	0.25
TOTAL	0.87	0.13

X^2=293.108; df=1; p<.001

TRANSFER STUDENT (1984-85)

	Trans.	N.Trans.
ACT	0.14	0.86
Non-ACT	0.63	0.37
TOTAL	0.31	0.69

X^2=348.806; df=1; p<.001

TRANSFER STUDENT (1985-86)

	Trans.	N.Trans.
ACT	0.17	0.83
Non-ACT	0.52	0.48
TOTAL	0.30	0.70

X^2=469.832; df=1; p<.001

HIGH SCHOOL GPA (1984-85)

	<3.00	>3.00
ACT	0.27	0.73
Non-ACT	0.44	0.56
TOTAL	0.30	0.70

X^2=17.701; df=1; p<.001

HIGH SCHOOL GPA (1985-86)

	<3.00	>3.00
ACT	0.31	0.69
Non-ACT	0.46	0.54
TOTAL	0.34	0.66

X^2=32.94; df=1; p<.001

MOTHER'S EDUCATION (1984-85)

	< HS	H.S.	S.Col.	Col.	S.Grad.	Grad.
ACT	0.05	0.32	0.34	0.18	0.04	0.07
Non-ACT	0.14	0.38	0.28	0.12	0.03	0.05
TOTAL	0.08	0.34	0.31	0.16	0.03	0.07

X^2=45.490; df=5; p<.001

MOTHER'S EDUCATION (1985-86)

	< HS	H.S.	S.Col.	Col.	S.Grad.	Grad.
ACT	0.06	0.29	0.31	0.21	0.03	0.09
Non-ACT	0.16	0.32	0.26	0.16	0.03	0.07
TOTAL	0.10	0.30	0.29	0.19	0.03	0.80

X^2=98.509; df=5; p<.001

FATHER'S EDUCATION (1984-85)

	< HS	H.S.	S.Col.	Col.	S.Grad.	Grad.
ACT	0.06	0.20	0.22	0.27	0.05	0.20
Non-ACT	0.18	0.19	0.23	0.18	0.03	0.19
TOTAL	0.11	0.20	0.22	0.24	0.04	0.19

X^2=53.226; df=5; p<.001

FATHER'S EDUCATION (1985-86)

	< HS	H.S.	S.Col.	Col.	S.Grad.	Grad.
ACT	0.06	0.19	0.21	0.28	0.04	0.22
Non-ACT	0.17	0.24	0.18	0.19	0.04	0.17
TOTAL	0.10	0.21	0.20	0.25	0.04	0.20

X^2=109.057; df=5; p<.001

PARENTS' INCOME (1984-85)

	< 10K	10-20K	20-30K	30-40K	40-50K	50-60K	60-70K	70K+	D.K.
ACT	0.02	0.07	0.13	0.17	0.15	0.10	0.09	0.13	0.14
Non-ACT	0.07	0.12	0.13	0.14	0.12	0.10	0.05	0.09	0.18
TOTAL	0.04	0.09	0.13	0.16	0.14	0.10	0.08	0.11	0.15

X^2=49.594; df=8; p<.001

PARENTS' INCOME (1985-86)

	< 10K	10-20K	20-30K	30-40K	40-50K	50-60K	60-70K	70K+	D.K.
ACT	0.02	0.07	0.11	0.15	0.16	0.12	0.08	0.16	0.12
Non-ACT	0.07	0.11	0.15	0.14	0.11	0.09	0.06	0.11	0.17
TOTAL	0.04	0.08	0.12	0.15	0.14	0.11	0.07	0.14	0.14

X^2=95.682; df=8; p<.001

SCHOLARSHIP STUDENT (1984-85)

	Yes	No
ACT	0.28	0.72
Non-ACT	0.15	0.85
TOTAL	0.23	0.77

X^2=29.615; df=1; p<.001

SCHOLARSHIP STUDENT (1985-86)

	Yes	No
ACT	0.29	0.71
Non-ACT	0.18	0.82
TOTAL	0.25	0.75

X^2=46.709; df=1 p<.00

WHERE STUDENT LIVES (1984-85)

	Dorm.	Frat.	Apart.	Home	Other
ACT	0.25	0.05	0.46	0.21	0.04
Non-ACT	0.17	0.02	0.48	0.27	0.06
TOTAL	0.22	0.03	0.47	0.23	0.05

X^2=22.658; df=4; p<.001

WHERE STUDENT LIVES (1985-86)

	Univ.	Frat.	< 1 mi	> 1 mi
ACT	0.29	0.05	0.19	0.46
Non-ACT	0.20	0.02	0.21	0.56
TOTAL	0.26	0.04	0.20	0.50

X^2=55.424; df=3; p<.001

WHERE STUDENT WORKS (1985-86)

	N.Work	Camp.	O.Camp.
ACT	0.45	0.18	0.37
Non-ACT	0.42	0.14	0.44
TOTAL	0.44	0.17	0.39

X^2=18.823; df=2; p<.001

HOURS WORKING (1985-86)

	None	1-9	10-19	20-29	30-39	40+
ACT	0.45	0.07	0.21	0.18	0.06	0.03
Non-ACT	0.41	0.06	0.18	0.17	0.07	0.11
TOTAL	0.43	0.07	0.20	0.18	0.06	0.06

X^2=77.733; df=5; p<.001

HOURS SOCIAL ACTIVITIES (1984-85)

	None	1-4	5-9	10-14	15-19	20+
ACT	0.01	0.18	0.32	0.25	0.13	0.11
Non-ACT	0.04	0.28	0.32	0.20	0.09	0.07
TOTAL	0.02	0.22	0.32	0.23	0.11	0.10

X^2=35.032; df=5; p<.001

HOURS IN CLASS (1985-86)

	1-4	5-9	10-14	15-19	20-24	25+
ACT	0.02	0.07	0.24	0.43	0.15	0.09
Non-ACT	0.04	0.13	0.24	0.37	0.15	0.08
TOTAL	0.03	0.09	0.24	0.41	0.15	0.09

X^2=38.320; df=5; p<.001

COMMUTER STUDENT (1984-85)

	Yes	No	D.K.
ACT	0.48	0.51	0.01
Non-ACT	0.58	0.38	0.04
TOTAL	0.52	0.46	0.02

X^2=23.371; df=2; p<.001

PART. FRESHMAN ORIENTATION (1985-86)

	Yes	No	D.K.
ACT	0.75	0.16	0.09
Non-ACT	0.56	0.24	0.20
TOTAL	0.69	0.19	0.12

X^2=123.704; df=2; p<.001

MEMBER CLUB/ORGANIZATION (1985-86)

	Yes	No
ACT	0.51	0.49
Non-ACT	0.40	0.60
TOTAL	0.47	0.53

X^2=28.591; df=1; p<.001

HONORS ENGLISH (1984-85)

	Yes	No
ACT	0.10	0.90
Non-ACT	0.03	0.97
TOTAL	0.08	0.92

X^2=24.099; df=1; p<.001

CAMPUS PLAYS (1984-85)

	None	1-4	5-9	10-14	15+
ACT	0.23	0.51	0.18	0.06	0.03
Non-ACT	0.42	0.36	0.16	0.04	0.03
TOTAL	0.30	0.45	0.17	0.05	0.03

X^2=57.127; df=4; p<.001

CAMPUS FILMS (1984-85)

	None	1-4	5-9	10-14	15+
ACT	0.19	0.36	0.22	0.12	0.12
Non-ACT	0.32	0.35	0.17	0.06	0.10
TOTAL	0.24	0.36	0.20	0.10	0.11

X^2=39.361; df=4; p<.001

CAMPUS CONCERTS (1984-85)

	None	1-4	5-9	10-14	15+
ACT	0.19	0.55	0.19	0.04	0.03
Non-ACT	0.36	0.47	0.13	0.03	0.01
TOTAL	0.25	0.52	0.17	0.04	0.02

X^2=52.807; df=4; p <.001

CAREER PLANNING & PLACEMENT (1984-85)

	Yes	No
ACT	0.51	0.49
Non-ACT	0.42	0.58
TOTAL	0.48	0.52

X^2=9.074; df=1; p<.01

INTRAMURAL SPORTS (1984-85)

	Never	Seldom	Occas.	Freq.
ACT	0.39	0.20	0.20	0.22
Non-ACT	0.59	0.15	0.13	0.13
TOTAL	0.47	0.18	0.17	0.18

X^2=55.946; df=3; p<.001

HONORS ENGLISH (1985-86)

	Yes	No
ACT	0.10	0.90
Non-ACT	0.04	0.96
TOTAL	0.08	0.92

X^2=33.908; df=1; p<.001

CAMPUS PLAYS (1985-86)

	None	1-4	5-9	10-14	15+
ACT	0.25	0.47	0.19	0.05	0.03
Non-ACT	0.41	0.38	0.13	0.04	0.03
TOTAL	0.31	0.44	0.17	0.05	0.03

X^2=81.143; df=4; p<.001

CAMPUS FILMS (1985-86)

	None	1-4	5-9	10-14	15+
ACT	0.20	0.38	0.21	0.09	0.12
Non-ACT	0.36	0.33	0.18	0.06	0.07
TOTAL	0.26	0.36	0.19	0.08	0.10

X^2=93.391; df=4; p<.001

CAMPUS CONCERTS (1984-85)

	None	1-4	5-9	10-14	15+
ACT	0.23	0.52	0.18	0.04	0.03
Non-ACT	0.39	0.43	0.12	0.03	0.02
TOTAL	0.29	0.49	0.16	0.04	0.03

X^2=87.323; df=4; p<.001

CAREER PLANNING & PLACEMENT (1984-85)

	Yes	No
ACT	0.54	0.46
Non-ACT	0.43	0.57
TOTAL	0.51	0.49

X^2=32.299; df=4; p<.001

INTRAMURAL SPORTS (1985-86)

	Never	Seldom	Occas.	Freq.
ACT	0.39	0.19	0.21	0.21
Non-ACT	0.57	0.13	0.15	0.14
TOTAL	0.45	0.17	0.19	0.18

X^2=87.669; df=3; p<.001

COUNSELING CENTER (1985-86)

	Never	Seldom	Occas.	Freq.
ACT	0.78	0.16	0.05	0.01
Non-ACT	0.76	0.15	0.06	0.02
TOTAL	0.78	0.16	0.05	0.01

X^2=14.557; df=3; p<.01

COMPUTER CENTER (1985-86)

	Never	Seldom	Occas.	Freq.
ACT	0.36	0.20	0.25	0.20
Non-ACT	0.44	0.18	0.20	0.18
TOTAL	0.39	0.19	0.23	0.19

X^2=18.182; df=3; p<.001

HOURS ON CAMPUS (1984-85)

	< 10	10-19	20-29	30+
ACT	0.36	0.23	0.08	0.33
Non-ACT	0.49	0.23	0.09	0.20
TOTAL	0.41	0.23	0.08	0.28

X^2=33.460; df=3; p<.001

HOURS ON CAMPUS (1985-86)

	< 10	10-19	20-29	30+
ACT	0.38	0.19	0.09	0.34
Non-ACT	0.48	0.21	0.10	0.21
TOTAL	0.42	0.20	0.09	0.29

X^2=53.621; df=3; p<.001

NATURAL SCIENCE COURSEWORK (1985-86)

	0	1	2	3	4+
ACT	0.15	0.49	0.13	0.15	0.08
Non-ACT	0.17	0.48	0.15	0.14	0.07
TOTAL	0.16	0.48	0.14	0.15	0.08

X^2=90.384; df=4; p<.001

MATHEMATICS COURSEWORK (1985-86)

	0	1	2	3	4+
ACT	0.12	0.25	0.10	0.31	0.22
Non-ACT	0.14	0.30	0.90	0.24	0.22
TOTAL	0.13	0.27	0.10	0.29	0.22

X^2=188.346; df=4; p<.001

HUMANITIES COURSEWORK (1985-86)

	0	1	2	3	4	5	6+
ACT	0.12	0.28	0.22	0.18	0.12	0.06	0.02
Non-ACT	0.12	0.31	0.19	0.17	0.11	0.07	0.03
TOTAL	0.12	0.29	0.21	0.18	0.12	0.06	0.02

X^2=114.984; df=6; p<.001

SOCIAL/APPLIED SCIENCES COURSEWORK (1985-86)

	0	1	2	3	4	5	6+
ACT	0.07	0.12	0.12	0.18	0.23	0.18	0.10
Non-ACT	0.07	0.16	0.13	0.22	0.21	0.13	0.08
TOTAL	0.07	0.13	0.12	0.20	0.22	0.16	0.09

X^2=168.239; df=6; p<.001

HISTORY COURSEWORK (1984-85)

	0	1	2	3+
ACT	0.43	0.49	0.07	0.01
Non-ACT	0.24	0.65	0.09	0.01
TOTAL				

X^2=49.536; df=3; p<.001

SATISFACTION SOCIAL EXPERIENCE (1984-85)

	V.Sat.	Sat.	Dissat.	V.Dis.
ACT	0.40	0.46	0.11	0.03
Non-ACT	0.28	0.55	0.13	0.03
TOTAL	0.36	0.50	0.12	0.03

X^2=18.232; df=3; p<.001

SATISFACTION SOCIAL EXPERIENCE (1985-86)

	V.Sat.	Sat.	Dissat.	V.Dis.
ACT	0.40	0.46	0.11	0.03
Non-ACT	0.31	0.51	0.14	0.05
TOTAL	0.37	0.48	0.12	0.04

X^2=30.779; df=3; p<.001

SATISFACTION ACADEMIC EXPERIENCE (1984-85)

	V.Sat.	Sat.	Dissat.	V.Dis.
ACT	0.22	0.63	0.12	0.02
Non-ACT	0.28	0.53	0.16	0.03
TOTAL	0.24	0.60	0.14	0.03

X^2=13.105; df=3; p<.01

SATISFACTION OVERALL EXPERIENCE (1984-85)

	V.Sat.	Sat.	Dissat.	V.Dis.
ACT	0.35	0.55	0.09	0.01
Non-ACT	0.28	0.58	0.12	0.02
TOTAL	0.32	0.56	0.10	0.02

X^2=12.288; df=3; p<.01

SATISFACTION OVERALL EXPERIENCE (1985-86)

	V.Sat.	Sat.	Dissat.	V.Dis.
ACT	0.33	0.55	0.10	0.02
Non-ACT	0.29	0.54	0.14	0.03
TOTAL	0.32	0.55	0.12	0.02

X^2=15.703; df=3; p<.001

PLAN TO REMAIN IN TENNESSEE (1985-86)

	Yes	No	D.K.
ACT	0.39	0.26	0.35
Non-ACT	0.46	0.25	0.29
TOTAL	0.42	0.26	0.33

X^2=12.430; df=2; p<.01

APPENDIX B:
MEAN GAIN SCORES FOR SELECTED VARIABLES
(1984-85 and 1985-86 UTK Senior Samples)

QUESTION	GAIN 1984-85	GAIN 1985-86
High School Grade Point Average		
Less Than 3.00	12.31	11.86
3.00 or Greater	8.00	6.61
College Grade Point Average		
Less Than 3.00		9.97
3.00 or Greater		5.33
Father's Education		
Less Than H.S.	12.60	11.17
H.S. Graduate	9.99	8.88
Some College	11.70	9.85
College Graduate	6.46	7.31
Some Grad. School	8.24	5.10
Graduate Degree	7.61	6.24
Received Academic Scholarship		
Yes	6.64	4.96
No	9.98	9.38
Where Student Lives		
University Housing		6.67
Fraternity		6.64
Less Than 1 Mile Away		7.66
More than 1 Mile Away		9.15
Where Student Works		
Not Working	7.04	
Working On Campus	9.01	
Working Off Campus	10.90	
Hours Per Week - Working		
None	7.09	
1 - 9	7.44	
10 - 19	10.21	
20 - 29	11.39	
30+	11.51	
Hours Per Week - Library Materials		
None	5.92	
1 - 2	8.92	
3 - 5	8.08	
6 - 8	11.30	
9 - 11	9.76	
12+	3.32	

QUESTION	GAIN 1984-85	GAIN 1985-86
Commuter Student		
Yes	10.50	
No	7.67	
Not Certain	7.22	
Freshman Orientation		
Yes		7.69
No		8.55
Didn't Know About		11.63
Honors English		
Yes	4.69	2.76
No	9.57	8.68
Honors Math		
Yes	-3.10	0.83
No	9.20	8.33
Use Computer Center		
Never		9.28
Seldom		9.14
Occasionally		7.44
Frequently		5.51
Natural Science Coursework		
None		10.04
1		9.23
2		8.85
3		5.38
4+		6.19
Mathematics Coursework		
None	8.97	12.03
1	11.27	9.33
2	10.01	8.15
3	8.98	9.52
4+	6.02	4.07

QUESTION	GAIN 1984-85	GAIN 1985-86
Social Science Coursework		
None	3.40	11.01
1	10.42	6.41
2	7.57	6.40
3	6.77	6.73
4	7.91	8.11
5	11.78	11.08
6+	11.76	10.83